Ultrasound Obstet Gynecol 2023; **61**: 518–525
Published online in Wiley Online Library (wileyonlinelibrary.com). **DOI:** 10.1002/uog.26155.

Modified Delphi study of ultrasound signs associated with placenta accreta spectrum

E. JAUNIAUX[1], F. D'ANTONIO[2], A. BHIDE[3], F. PREFUMO[4], R. M. SILVER[5], A. M. HUSSEIN[6], S. A. SHAINKER[7], F. CHANTRAINE[8] and Z. ALFIREVIC[9]; Delphi consensus expert panel[#]

[1]*EGA Institute for Women's Health, Faculty of Population Health Sciences, University College London, London, UK;* [2]*Center for Fetal Care and High-Risk Pregnancy, Department of Obstetrics and Gynecology, University of Chieti, Italy;* [3]*Fetal Medicine Unit, Department of Obstetrics and Gynaecology, St George's Hospital, London, UK;* [4]*Obstetrics and Gynaecology Unit, IRCCS Istituto Giannina Gaslini, Genoa, Italy;* [5]*Department of Obstetrics and Gynecology, University of Utah Health, Salt Lake City, UT, USA;* [6]*Department of Obstetrics and Gynecology, University of Cairo, Cairo, Egypt;* [7]*Department of Obstetrics and Gynecology, Beth Israel Deaconess Medical Center, Boston, MA, USA;* [8]*Department of Obstetrics and Gynecology, Centre Hospitalier Universitaire de Liège, CHR Citadelle, Liège, Belgium;* [9]*Department of Women's and Children's Health, University of Liverpool, Liverpool, UK*

KEYWORDS: Delphi survey; placenta accreta spectrum; placenta previa accreta; systematic review; ultrasound imaging

CONTRIBUTION

What are the novel findings of this work?
Using a structured Delphi process informed by a systematic review, we found that targeted detailed sonography looking for most established standardized ultrasound signs of placenta accreta spectrum (PAS) and involvement of the cervix is recommended for the prenatal evaluation of pregnant patients at high risk for PAS.

What are the clinical implications of this work?
Pregnant women at high risk for PAS at birth should be referred to specialist centers with expertise in abnormal placentation. Prenatal evaluation should include transvaginal ultrasound to confirm the precise position of the placenta and anatomy of the cervix. New ultrasound signs that can be obtained using standard ultrasound equipment should be included in future clinical research.

ABSTRACT

Objective *To determine, by expert consensus through a modified Delphi process, the role of standardized and new ultrasound signs in the prenatal evaluation of patients at high risk of placenta accreta spectrum (PAS).*

Methods *A systematic review of articles providing information on ultrasound imaging signs or markers associated with PAS was performed before the development of questionnaires for the first round of the Delphi process. Only peer-reviewed original research studies in the English language describing one or more new ultrasound sign(s) for the prenatal evaluation of PAS were included. A three-round consensus-building Delphi method was then conducted under the guidance of a steering group, which included nine experts who invited an international panel of experts in obstetric ultrasound imaging in the evaluation of patients at high risk for PAS. Consensus was defined as agreement of ≥ 70% between participants.*

Results *The systematic review identified 15 articles describing eight new ultrasound signs for the prenatal evaluation of PAS. A total of 35 external experts were approached, of whom 31 agreed and participated in the first round. Thirty external experts (97%) and seven experts from the steering group completed all three Delphi rounds. A consensus was reached that a prior history of at least one Cesarean delivery, myomectomy or PAS should be an indication for detailed PAS ultrasound assessment. The panelists also reached a consensus that seven of the 11 conventional signs of PAS should be included in the examination of high-risk patients and the routine mid-gestation scan report: (1) loss of the 'clear zone', (2) myometrial thinning, (3) bladder-wall interruption, (4) placental bulge, (5) uterovesical hypervascularity, (6) placental lacunae and (7) bridging vessels. A consensus was not reached for any of the eight new signs identified by*

Correspondence to: Prof. E. Jauniaux, Institute for Women's Health, University College London, 86–96 Chenies Mews, London WC1E 6HX, UK (e-mail: e.jauniaux@ucl.ac.uk)

#Delphi consensus expert panel is listed at end of article.

Accepted: 20 December 2022

the systematic review. With respect to other ultrasound features that are not specific to PAS but increase the probability of PAS at birth, the panelists reached a consensus for the finding of anterior placenta previa or placenta previa with cervical involvement. The experts were also asked to determine which PAS signs should be quantified and consensus was reached only for the quantification of placental lacunae using an existing score. For predicting surgical outcome in patients with a high probability of PAS at delivery, a consensus was obtained for loss of the clear zone, bladder-wall interruption, presence of placental lacunae and presence of placenta previa involving the cervix.

Conclusions *We have confirmed the continued importance of seven established standardized ultrasound signs of PAS, highlighted the role of transvaginal ultrasound in evaluating the placental position and anatomy of the cervix, and identified new ultrasound signs that may become useful in the future prenatal evaluation and management of patients at high risk for PAS at birth.*

INTRODUCTION

Placenta accreta spectrum (PAS) occurs when the gestational sac implants and the definitive placenta develops within a uterine scar area[1,2]. The loss and remodeling of the normal uterine wall structure following surgery allows the extravillous trophoblast to reach and contribute to the transformation of large peripheral uterine arteries under the scar area[3]. Continuous high-pressure arterial intervillous flow is likely to be the main cause of the increase in fibrinoid deposition at the uteroplacental interface with progressive distortion of the above cotyledonary architecture[4]. Loss of parts of the physiological placental detachment from the uterine site is associated with high maternal morbidity and sometimes mortality due to massive obstetric hemorrhage, particularly when the surgeon is unaware and attempts to detach the accreta area manually at delivery[5].

The prenatal diagnosis of PAS is associated with reduced hemorrhagic morbidity at delivery[6]. In 1982, Tabsh *et al.*[7] were the first to describe the ultrasound features of a case of placenta increta with gray-scale imaging (GSI). A decade later, using color Doppler imaging (CDI), Chou *et al.*[8] first reported on the changes in the uteroplacental circulation associated with PAS. There has been considerable variability in the ultrasound equipment and signs and diagnostic criteria used for the perinatal evaluation of PAS[9] and, in particular, of its most common form, i.e. placenta previa accreta[10]. In 2016, the European Working Group on abnormally invasive placenta (EW-AIP) proposed a list of standardized ultrasound signs for PAS, identified up to February 2013[11].

Over the last decade, new ultrasound signs of PAS have been reported in the international literature. Thus, we conducted a survey using a modified Delphi methodology including a systematic review to gain an expert consensus on the role of old and new ultrasound signs in the prenatal evaluation and management of patients at high risk of PAS at birth. The Delphi technique was selected because it has been widely used to generate robust consensus in healthcare research[12].

METHODS

Systematic literature review

A systematic review of articles providing data on ultrasound imaging signs or markers associated with PAS was performed before the development of the questionnaire for the first round of the Delphi procedure, as suggested by Sinha *et al.*[12]. PubMed, Google Scholar and MEDLINE were searched for studies published between the systematic review by Jauniaux *et al.*[9], which ended on 30 March 2016, and 31 May 2022. The search protocol was designed *a priori* by E.J. and A.B. and completed in compliance with the guidelines for Preferred Reporting Items for Systematic Reviews and Meta-Analysis[13]. The overall search strategy included Medical Subject Headings (MeSH) for the following terms: 'placenta accreta' OR 'placenta increta' OR 'placenta percreta' OR 'abnormally invasive placenta' OR 'morbidly adherent placenta' OR 'placenta adhesive disorder'. We combined these with terms related to 'sonography', 'ultrasound imaging', 'new ultrasound sign', 'gray-scale imaging', 'three-dimensional (3D) ultrasound' and 'color Doppler imaging (CDI)'. Searches of the title and abstract fields were performed. The reference lists of selected studies were searched manually for additional eligible papers. Only peer-reviewed original research studies in the English language describing one or more new ultrasound sign(s) for the prenatal evaluation of PAS were included. Exclusion criteria included reviews, opinions, letters, protocols, conference proceedings, articles published after 31 May 2022 and non-human studies. Retrieved papers were reviewed and information extracted independently by E.J. and A.B.. Any disagreement was resolved by consultation with a third author (Z.A.).

Steering group and expert panel

The steering group included nine experts; E.J. and Z.A. designed the questionnaires and seven members provided valuable feedback. The decision was made that E.J. and Z.A. would not participate in the Delphi process but the other seven members would remain eligible.

Thirty-five additional experts were subsequently invited by e-mail after recommendation by their colleagues on the steering group. Potential participants were sent the study information including an invitation letter and a copy of the Delphi protocol by e-mail.

Each member of the steering group was asked to provide the name(s) of up to four experts, defined as

clinicians with at least 10 years' experience in obstetric ultrasound imaging including PAS who had published at least one recent article on the use of ultrasound imaging in the prenatal evaluation of PAS and/or have an affiliation with a national or international organization dedicated to improving the diagnosis and management of PAS. The final list included individuals who replied to our invitation, citing an interest in being involved in the Delphi process. Once prospective panelists agreed to participate in the study, their e-mail addresses were added to the final participant list for survey distribution and were invited to be listed as collaborators on a future publication. All responses to the questionnaires were received through an independent third-party e-mail to ensure anonymity.

Overall, the final panel included 37 experts from 21 different countries, including four from low- and middle-income countries. Recruitment and the three rounds of Delphi questionnaires were completed over a 3-month period between August and November 2022.

Delphi rounds

A three-round Delphi consensus method was performed to identify the ultrasound signs or markers of PAS and evaluate the use of these signs in future clinical research studies. The questionnaires for the three rounds were developed by E.J. and Z.A., and reviewed and approved by the steering panel. These questions concerned: (1) clinical, demographic and sonographic criteria used to define patients at high risk of PAS at birth; (2) the relevance of each ultrasound sign in the prenatal evaluation of patients at high risk of PAS at birth; (3) the optimal gestational age at which to assess for signs suggesting PAS during the second half of pregnancy; (4) the relevance of various established ultrasound techniques available on standard ultrasound machines (such as transvaginal ultrasound (TVS), CDI, pulsed-Doppler ultrasound and three-dimensional (3D) (Doppler) ultrasound) and new ultrasound techniques in acquiring old and new ultrasound signs associated with PAS; and (5) the value of established and new ultrasound signs and other ultrasound features in the prenatal assessment and evaluation of surgical outcomes in patients at high risk for PAS at birth.

After the first round, the answers to each question from all the experts were analyzed and corresponding data were used to develop questionnaires for the second and third rounds. All the experts who agreed to participate in the Delphi procedure were invited to participate in the second and third rounds only if they had replied to the first questionnaire. The experts were given 10 days to provide their final responses to each questionnaire, and a single reminder was sent if no response was received within 2 weeks.

A consensus was predefined as proportion of agreement of $\geq 70\%$. The rate of agreement (RoA) was calculated for the third questionnaire as: RoA = (agreement – disagreement)/(agreement + disagreement + unsure) × 100.

In the Round 1 questionnaire, participants were asked to: (1) identify demographic and clinical characteristics that are associated with a higher risk of PAS at birth, based on which detailed PAS ultrasound assessment is indicated; (2) select the ultrasound signs that should be included in the routine mid-gestation scan report of high-risk patients based on risk factors and/or placental appearance; and (3) select second- or third-trimester non-PAS ultrasound features that increase the probability of PAS at birth.

In Round 2, the participants were asked to select the optimal gestational age at which to identify ultrasound signs associated with PAS and to determine which signs should be quantified. Participants were also asked to provide suggestions on how to quantify the different signs. Only ultrasound signs that reached an agreement of $\geq 70\%$ in Round 1 were included in Round 2.

In Round 3, the participants were sent a single questionnaire that focused on ultrasound signs of PAS and other features to be used for future clinical research on predicting surgical outcomes in patients with a high probability of PAS at birth. This questionnaire also included ultrasound signs of PAS from Round 1 for which no agreement was reached, but that could be obtained using standard ultrasound equipment.

RESULTS

Literature search

The initial database search identified 1248 articles, and manual reference checking provided an additional three studies, making a total of 1251 potentially relevant articles. After exclusion of duplicates and two articles that were not available, 880 remained, of which a further 793 were excluded after screening the titles and abstracts, as the data they reported were not relevant. The remaining 87 studies were retrieved for full-text review, of which 72 were excluded after in-depth review, leaving 15 studies describing eight new ultrasound signs for the prenatal evaluation of PAS[14–28]. The process of selection of these articles is summarized in Figure S1, and the characteristics of the 15 studies identified by the systematic review are presented in Table S1.

Delphi procedure

A total of 37 experts (seven from the steering group and 30 external) completed all three rounds of the Delphi questionnaires.

Delphi round 1

In the first round, 11 demographic and clinical characteristics were presented to the experts to determine which should be used to identify high-risk patients in whom detailed PAS ultrasound assessment is indicated (Table S2). A consensus was reached on four of the 11 characteristics, namely, a history of one Cesarean delivery (CD), multiple prior CDs, myomectomy or PAS.

Of the 11 established standardized ultrasound signs of PAS[11], a consensus of ≥ 70% was reached among the panelists for seven signs that should be assessed and included in the routine mid-gestation scan report of high-risk patients (Table 1). These comprised loss of the 'clear zone' (hypoechoic retroplacental zone), myometrial thinning, bladder-wall interruption, presence of a placental bulge, uterovesical hypervascularity, placental lacunae and bridging vessels. None of the eight new signs identified in the present systematic review[14–28] reached a predefined consensus threshold as ultrasound findings that increase the probability of PAS at birth (Table 1). In addition, the panel was queried about second- or third-trimester ultrasound findings that are not specific for PAS (i.e. placental position, placental thickness, anatomy of the cervix, multiple pregnancy and abnormal fetal growth) yet may increase the probability of PAS at birth (Table S3). A consensus was obtained for the presence of anterior placenta previa, defined as the placental edge being < 0.5 cm from the internal os or the placenta completely covering it[29], and placenta previa with cervical involvement.

Delphi round 2

No consensus was reached among the panelists regarding the optimal gestational age at which to identify the different ultrasound signs associated with PAS that

Table 1 Agreement, according to a Delphi consensus, of 37 experts regarding reporting of 11 established and eight new ultrasound signs at mid-gestation scan in pregnant patients at high risk of placenta accreta spectrum

Ultrasound sign	*Imaging method*	*Description*	*Agreement (n (%))*
Established signs			
Placental lacunae[11]	GSI and CDI	Large, irregular, hypoechoic (without a hyperechogenic halo) intraplacental spaces located above large feeder vessels, giving the placenta a 'moth-eaten' appearance (containing turbulent flow)	36 (97)
Loss of 'clear zone' (hypoechoic retroplacental zone)[11]	GSI	Loss or irregularity of normal hypoechoic interface between the uterine wall and placental basal plate	35 (95)
Bladder-wall interruption[11]	GSI	Partial or complete interruption, loss or irregularity of bladder wall or of the hyperechoic line between uterine serosa and bladder lumen	33 (89)
Placental bulge[11]	GSI	'Ballooning' of the uterus containing the placenta into surrounding pelvic structure	33 (89)
Uterovesical hypervascularity[11]	CDI	Striking amount of color Doppler signal seen in the placental bed of a low-lying placenta/placenta previa, and bladder wall demonstrating multidirectional flow and aliasing artifact	33 (89)
Myometrial thinning[11]	GSI	Myometrial thickness < 1 mm or undetectable	28 (76)
Bridging vessels[11]	CDI	Vessels appearing to extend from the placental bed, across the uterine wall into the bladder or other pelvic organs	28 (76)
Exophytic mass[11]	GSI	Focal area of myometrium at which placenta appears to protrude outside the uterine wall	25 (68)
Placental lacunae feeder vessel(s)[11]	CDI	Large vessel(s) located under lacuna(e)	25 (68)
Subplacental hypervascularity[11]	CDI	Striking amount of color Doppler signal seen in placental bed demonstrating multidirectional flow and aliasing artifact	22 (59)
Intraplacental hypervascularity[11]	3D-CDI	Complex, irregular arrangement of numerous placental vessels, exhibiting tortuous courses and varying calibers	21 (57)
New signs			
Intracervical lakes[22]	TVS-CDI	Tortuous hypervascularized anechoic spaces within cervix	25 (68)
Obliteration of retroplacental clear space (tramline appearance)[16,17,20,25]	3D-GSI and 3D-CDI/4D volume rendering (crystal vue/realistic vue)	'Partial obliteration' is defined as loss of some or part of the uterus–bladder interface; 'full obliteration' as complete obliteration of the uterus–bladder interface	17 (46)
Rail sign[24]	CDI	Two parallel enlarged vessels over the uterovesical junction and bladder mucosa, with interconnecting bridging vessels perpendicular to both	14 (38)
Increased parametrial vascularity[21]	CDI	Complex, irregular arrangement of vessels, exhibiting tortuous courses and varying calibers in the parametrial region	14 (38)
Pulsatile vessel at posterior bladder wall[26]	CDI	Pulsatile arterial vessels with low resistance index at the posterior bladder wall	12 (32)
Missing decidual signal[18,23]	SMI	Absence of Doppler signals under the basal plate and obliterated myometrium	3 (8)
Non-tapered placental edge[27]	GSI	Presence of blunt or wide amount of trophoblast at the placental edge in the sagittal plane	3 (8)
High ARFI elastography scores[14,15,19,28]	GSI/VTQ	Shear-wave elastography velocity evaluation of placental stiffness (mean > 1.92 m/s)	1 (3)

3D, three-dimensional; 4D, four-dimensional; ARFI, acoustic radiation force impulse; CDI, color Doppler imaging; GSI, grayscale imaging; SMI, Superb Microvascular Imaging; TVS, transvaginal sonography; VTQ, virtual touch quantification.

Table 2 Responses of 37 experts participating in Delphi process regarding ultrasound signs associated with a high probability of placenta accreta spectrum that should be quantified, and recommended quantitative assessment methods

	Need for quantitative assessment		
Ultrasound sign	*Yes*	*No*	*Recommended method (number of experts)*
Loss of 'clear zone'	4 (11)	33 (89)	TAS measurement of area size ($n=2$) and describe them as focal (< 5 cm in length) or diffuse (> 5 cm in length) ($n=1$) Score proposed by Del Negro *et al.*[31]: 0, present; 1, irregular; 2, absent ($n=1$)
Myometrial thinning	19 (51)	18 (49)	TAS measurement of RMT obtained perpendicular to long axis of uterus and measured at thinnest part with proposed cut-off of: < 1 mm ($n=9$); < 2.5 mm ($n=1$); and < 3 mm ($n=1$) TVS measurement of RMT at 5 cm from internal os ($n=1$) Average of three RMT measurements at different levels between internal os and top of bladder ($n=1$) RMT ratio between scar area and intact myometrium outside ($n=2$) TAS measurement of area size ($n=2$)
Bladder-wall interruption	5 (14)	32 (86)	TAS measurement of area size ($n=3$) Score proposed by Del Negro *et al.*[31]: 0, line clear and complete; 1, line vague or irregular; 2, line lost ($n=1$)
Placental bulge	7 (19)	30 (81)	TAS measurement of area size ($n=4$), categorized as follows: < 2 cm of bulge length and < 1 cm protrusion into partially/fully filled bladder; 2–5 cm of bulge length and 1–3 cm protrusion into bladder; > 5 cm of bulge length regardless of 'depth' of protrusion into the bladder ($n=1$) Evaluation of location: above bladder; below level of internal os or towards parametrium ($n=1$)
Uterovesical hypervascularity	13 (35)	24 (65)	TAS-CDI measurements of surface area of confluence (on 3D) or greatest linear extent (on 2D) ($n=1$) Score proposed by Del Negro *et al.*[31]: 1, increased flow, presence of numerous vessels, tortuous; 2, multidirectional flow or presence of bridging vessels ($n=1$)
Placental lacunae	27 (73)	10 (27)	TAS and TVS score proposed by Finberg and Williams[30]: 0, none; 1+, 1–3; 2+, 4–6; 3+, > 6 ($n=26$) Measurement of lacunae size > 20 mm ($n=1$)
Bridging vessels	15 (41)	22 (59)	TAS count of number of vessels ($n=7$) and measurement of surface area ($n=1$) Measurement of PSV ($n=2$)

Data are given as *n* (%). 2D, two-dimensional; 3D, three-dimensional; CDI, color Doppler imaging; PSV, peak systolic velocity; RMT, residual myometrial thickness; TAS, transabdominal sonography; TVS, transvaginal sonography.

reached a consensus in Round 1 (Table S4). Four experts recommended the 11–14-week scan period. There was a consensus to quantify the presence of placental lacunae, but no consensus was reached for any of the other signs (Table 2). The method of choice to quantify placental lacunae for 26 of the 37 (70%) of the panelists was the score proposed by Finberg and Williams[30]. Quantitative methods were also proposed for measuring the size of the area with loss of the clear zone, myometrial thinning, bladder-wall interruption, placental bulge, uterovesical hypervascularity and bridging vessels (Table 2). One expert suggested use of the scores proposed recently by Del Negro *et al.*[31] to quantify loss of the clear zone, bladder-wall interruption and uterovesical hypervascularity.

Delphi round 3

Table 3 displays the RoA among experts regarding the role of the standardized ultrasound signs that reached a strong consensus in Round 1, new signs identified by the systematic review that can be obtained using regular ultrasound equipment and other ultrasound features that may predict surgical outcome at delivery. A consensus was obtained for loss of the clear zone, bladder-wall

Table 3 Responses and rate of agreement (RoA) of 37 experts participating in Delphi process, regarding role of proposed ultrasound signs and features for future research in predicting surgical outcome in patients with high probability of placenta accreta spectrum at birth

Ultrasound sign	*Agree*	*Disagree*	*Unsure*	*RoA (%)*
Placenta previa with cervical involvement	34	1	2	89
Bladder-wall interruption	34	2	1	86
Loss of 'clear zone'	30	4	3	70
Placental lacunae	30	4	3	70
Bridging vessels	28	4	5	65
Placental bulge	28	5	4	62
Subplacental/uterovesical hypervascularity	27	5	5	59
Myometrial thinning	25	5	7	54
Intracervical lakes	22	7	8	41
Placenta previa reaching but not covering internal os	24	11	2	35
'Rail sign'	6	15	16	24
Cervical length/funneling	11	16	10	14
Placental lacunae feeder vessel(s)	14	10	13	11
Placental lacunae feeder vessel(s) with PSV ≥ 41 cm/s	11	12	14	3

PSV, peak systolic velocity.

interruption, presence of placental lacunae and placenta previa involving the cervix, i.e. partially or completely covering the internal os of the cervix.

DISCUSSION

Main findings

Consensus was reached for seven of the 11 standardized TAS signs currently used in the prenatal evaluation of patients at high risk for PAS at birth. The panel also agreed that TVS evaluation of the lower segment could contribute to both prenatal management and predicting surgical outcome. By contrast, none of eight new ultrasound signs associated with PAS identified in the systematic review was endorsed by more than 70% of the panelists, perhaps owing to technical limitations related to the availability of specific software on routine ultrasound equipment and/or limited prospective data on their use.

Comparison with other studies

Transabdominal sonography (TAS) descriptors of PAS proposed by the EW-AIP were developed in 2014 during a meeting of 29 European healthcare professionals and basic science researchers with an interest in abnormal placentation[11]. They used the antenatal ultrasound signs of PAS identified in a systematic review of 23 studies published before 7 February 2013[32]. Our modified Delphi process involved 37 experts in obstetric ultrasound imaging and included the evaluation of risk factors for PAS, both TAS and standardized TVS-PAS signs, the possible quantification of the signs and determination of the gestational age at which signs are best identified. We also evaluated the role of new ultrasound signs that can be obtained using regular ultrasound equipment in determining surgical outcomes.

The vast majority of PAS cases are now found in patients with at least one prior CD, presenting with placenta previa[5,10,33,34], and targeted ultrasound screening protocols for these patients improve perinatal outcomes[35]. In our Delphi study, the experts agreed that a higher risk of PAS is associated with a history of at least one previous CD, myomectomy or prior PAS (Table S2) and the presence of anterior placenta previa and placenta previa with cervical involvement on TVS (Table S3). Pregnant patients with a history of CD or PAS, presenting with an anterior low-lying placenta/placenta previa at the routine mid-pregnancy scan should be systematically referred to a specialist unit with expertise in the imaging of abnormal placentation[36]. The panel also advised screening for PAS in patients with prior myomectomy, however, the risk of PAS after myomectomy is low[37] and only nine cases of myomectomy scar pregnancies have been reported[38].

There are limited data on the evolution and changes of ultrasound signs associated with PAS with advancing gestation[3,39–44]. A multivariate analysis found that true-positive cases of PAS were more likely to present after 16 weeks' gestation with loss of the clear zone, myometrial thinning, irregular bladder wall, placental lacunae and vascular abnormalities on CDI[40]. Only a few of the panelists recommended the evaluation of PAS signs at 11–14 weeks (Table S4). Some panel members also advised measuring the corresponding surface area of the different signs (Table 2). These signs are likely to be more pronounced in the third trimester, in particular in patients with multiple prior CDs. Twenty-seven experts recommended a quantitative assessment for placental lacunae and use of the score of Finberg and Williams[30]. The definition of what constitutes subplacental or uterovesical 'hypervascularity' remains elusive. Haidar *et al.*[45] found that use of Virtual Organ Computer-Aided Analysis software to calculate the vascularization index of subplacental blood flow in high-risk patients at 28–32 weeks can predict PAS at birth. These new scores and index systems require independent evaluation and validation by other researchers before being recommended for clinical use.

Our systematic review identified eight new ultrasound signs of PAS at birth (Table 1). Three of these signs require ultrasound techniques and/or software that are not available on routine ultrasound machines, limiting their widespread use in clinical practice. A recent report by the Society for Maternal–Fetal Medicine[46], indicates that most studies on the prenatal ultrasound evaluation of PAS are retrospective in design and lack 'low-risk' control comparison groups. Of the 15 studies identified in the present systematic review, only five involved prospective cohorts and three were case–control studies (Table S1), indicating the need for further prospective case–control studies.

Strengths and limitations

The Delphi method used in our study is a well-established process for obtaining group consensus on complex topics, and it avoids situations in which the group is dominated by the views of a few individuals[12,47]. We included international experts in obstetric ultrasound, with different nationalities and with diverse expertise to ensure that multiple participant views would be captured. Some of the new ultrasound signs included in the questionnaire of the first round were obtained from articles published recently and thus may not have been tested by most of the panelists, thus limiting the generalizability of our results.

Future perspectives

PAS is a clinicopathologic diagnosis and, as such, prenatal imaging can only provide an estimation of the probability of finding abnormal attachment of one or more placental cotyledons to the uterine wall at birth. Ultrasound imaging can contribute to the preoperative evaluation of patients with a high probability of PAS[21,24,25,31,48–52]. Abnormalities of uteroplacental circulation[21,24,49,52] on TAS and short cervical length on TVS[48,50] increase the odds of intraoperative complications. Major disruptions of the uterine wall architecture, such as those associated with placental bulge, are also associated more strongly with intrapartum hemorrhage compared with the findings of accreta villous tissue[52]. Our panelists reached a consensus that loss of the clear zone, bladder-wall

interruption and the presence of placental lacunae and placenta previa involving the cervix can predict surgical outcomes (Table 3). A consensus was reached that the presence of placenta previa with involvement of the cervix (i.e. partially or completely covering the internal os) is associated with increased risk of PAS at birth (Table S3) and 25 out of 37 (68%) panelists identified intracervical lakes as a new ultrasound sign to be reported in patients at high risk for PAS (Table 1). These findings highlight the pivotal role of TVS in the prenatal evaluation of PAS.

Conclusions

Using a robust consensus technique, supported by a systematic review, we found that established standardized ultrasound signs continue to be used worldwide in the evaluation of patients at high risk for PAS, and we highlighted the role of TVS in this evaluation. Further research should include large, prospective, multicenter, international cohorts followed longitudinally with clear definitions of ultrasound signs that can be obtained using standard ultrasound equipment in the screening of patients at high risk for PAS.

PAS ultrasound imaging expert panel included in Delphi consensus

Alfred Abuhamad, Eastern Virginia Medical School, Norfolk, VA, USA
Rozi Aditya Aryananda, Universitas Airlangga, Surabaya, Indonesia
Giuseppe Calì, University of Palermo, Palermo, Italy
Conrado M Coutinho, Universidade de São Paulo, São Paulo, Brazil
Andrea Dall'Asta, University of Parma, Parma, Italy
Maria de Carvalho Afonso, University of Lisbon, Lisbon, Portugal
Veronica M Deniega, Brokenshire Memorial Hospital, Davao City, Philippines
Brett Einerson, University of Utah Health Science, Salt Lake City, UT, USA
Karin A Fox, Baylor College of Medicine, Houston, TX, USA
Matus Halaj, Charles University in Prague, Czech Republic
Petra Hanulikova, Charles University in Prague, Czech Republic
Anne Kennedy, University of Utah Health Science, Salt Lake City, UT, USA
John C Kingdom, University of Toronto, Toronto, Canada
Christoph Lees, Imperial College London, London, UK
Kwok-Yin Leung, University of Hong Kong, Pok Fu Lam, Hong Kong SAR
Wing-Cheong Leung, University of Hong Kong, Pok Fu Lam, Hong Kong SAR
Zhengping Liu, Southern Medical University, Guandong, People's Republic of China
Wolfgang Henrich, Charité University Medicine Berlin, Berlin, Germany
Ron Maymon, Tel Aviv University, Tel Aviv, Israel
Mina G Mhallem, Universite Catholique de Louvain, Louvain-la-Neuve, Belgium
Olivier Morel, Centre Hospitalier Régional Universitaire of Nancy, Nancy, France
Martha Rac, Baylor College of Medicine, Houston, TX, USA
Marcus Rijken, Utrecht University, Utrecht, The Netherlands
Jin-Chung Shih, National Taiwan University Hospital, Taipei, Taiwan
Vedran Stefanovic, University of Helsinki, Helsinki, Finland
Karin Sundberg, University of Copenhagen, Copenhagen, Denmark
Paula Woodward, University of Utah Health Science, Salt Lake City, UT, USA
Huixia Yang, Peking University First Hospital, Peking, People's Republic of China
Nurit Zosmer, The Fetal Medicine Research Institute, King's College London, London, UK
Lisa C Zuckerwise, Vanderbilt University Medical Center, Nashville, TN, USA

REFERENCES

1. Jauniaux E, Jurkovic D. Placenta accreta: pathogenesis of a 20th century iatrogenic uterine disease. *Placenta* 2012; **33**: 244–251.
2. Jauniaux E, Jurkovic D, Hussein AM, Burton GJ. New insights into the etiopathology of placenta accreta spectrum. *Am J Obstet Gynecol* 2022; **227**: 384–391.
3. Jauniaux E, Zosmer N, De Braud LV, Ashoor G, Ross J, Jurkovic D. Development of the utero-placental circulation in cesarean scar pregnancies: a case–control study. *Am J Obstet Gynecol* 2022; **226**: 399.e1–399.e10.
4. Jauniaux E, Hussein AM, Elbarmelgy RM, Elbarmelgy RA, Burton GJ. Failure of placental detachment in accreta placentation is associated with excessive fibrinoid deposition at the utero-placental interface. *Am J Obstet Gynecol* 2022; **226**: 243.e1–243.e10.
5. Silver RM, Branch DW. Placenta Accreta Spectrum *N Engl J Med* 2018; **378**: 1529–1536.
6. Buca D, Liberati M, Calì G, Forlani F, Caisutti C, Flacco ME, Manzoli L, Familiari A, Scambia G, D'Antonio F. Influence of prenatal diagnosis of abnormally invasive placenta on maternal outcome: systematic review and meta-analysis. *Ultrasound Obstet Gynecol* 2018; **52**: 304–309.
7. Tabsh KM, Brinkman CR 3rd, King W. Ultrasound diagnosis of placenta increta. *J Clin Ultrasound* 1982; **10**: 288–290.
8. Chou MM, Ho ES, Lu F, Lee YH. Prenatal diagnosis of placenta previa/accreta with color Doppler ultrasound. *Ultrasound Obstet Gynecol* 1992; **2**: 293–296.
9. Jauniaux E, Collins SL, Jurkovic D, Burton GJ. Accreta placentation: a systematic review of prenatal ultrasound imaging and grading of villous invasiveness. *Am J Obstet Gynecol* 2016; **215**: 712–721.
10. Jauniaux E, Grønbeck L, Bunce C, Langhoff-Roos J, Collins SL. Epidemiology of placenta previa accreta: a systematic review and meta-analysis. *BMJ Open* 2019; **9**: e031193.
11. Collins SL, Ashcroft A, Braun T, Calda P, Langhoff-Ross J, Morel O, Stefanovic V, Tutschek B, Chantraine F; European Working Group on Abnormally Invasive Placenta (EW-AIP). Proposal for standardized ultrasound descriptions of abnormally invasive placenta (AIP). *Ultrasound Obstet Gynecol* 2016; **47**: 271–275.
12. Sinha IP, Smyth RL, Williamson PR. Using the Delphi technique to determine which outcomes to measure in clinical trials: recommendations for the future based on a systematic review of existing studies. *PLoS Med* 2011; **8**: e1000393.
13. Liberati A, Altman DG, Tetzlaff J, Mulrow C, Gøtzsche PC, Ioannidis JP, Clarke M, Devereaux PJ, Kleijnen J, Moher D. The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: explanation and elaboration. *J Clin Epidemiol* 2009; **62**: e1–34.
14. Alıcı Davutoglu E, Ariöz Habibi H, Ozel A, Yuksel MA, Adaletli I, Madazlı R. The role of shear wave elastography in the assessment of placenta previa–accreta. *J Matern Fetal Neonatal Med* 2018; **31**: 1660–1662.
15. Cim N, Tolunay HE, Boza B, Arslan H, Ates C, İlik İ, Tezcan FM, Yıldızhan R, Sahin HG, Yavuz A. Use of ARFI elastography in the prediction of placental invasion anomaly via a new Virtual Touch Quantification Technique. *J Obstet Gynaecol* 2018; **38**: 911–915.
16. Dall'Asta A, Shah H, Masini G, Paramasivam G, Yazbek J, Bourne T, Lees CC. Evaluation of tramline sign for prenatal diagnosis of abnormally invasive placenta using three-dimensional ultrasound and Crystal Vue rendering technology. *Ultrasound Obstet Gynecol* 2018; **52**: 403–404.

17. Aryananda RA, Akbar A, Wardhana MP, Gumilar KE, Wicaksono B, Ernawati E, Sulistyono A, Aditiawarman A, Joewono HT, Dachlan EG, Parange A, Dekker GA. New three-dimensional/four-dimensional volume rendering imaging software for detecting the abnormally invasive placenta. *J Clin Ultrasound* 2019; **47**: 9–13.
18. Hasegawa J, Kurasaki A, Hata T, Homma C, Miura A, Kondo H, Suzuki N. Diagnosis of placenta accreta spectrum using ultra-high-frequency probe and Superb Microvascular Imaging. *Ultrasound Obstet Gynecol* 2019; **54**: 705–707.
19. Bayramoğlu Tepe N, Gelebek Yilmaz F, Bozdag Z, Uğur MG. Subgroup analysis of accreta, increta and percreta cases using acoustic radiation force impulse elastography. *J Obstet Gynaecol Res* 2020; **46**: 699–706.
20. Chen S, Chen Q, Du X, Chen S, Li W, Chen S. Value of Crystal Vue technique in detecting the placenta accreta spectrum located in c-section scar area. *Med Ultrason* 2020; **22**: 438–444.
21. Dall'Asta A, Calì G, Forlani F, Paramasivam G, Girardelli S, Yazbek J, D'Antonio F, Bhide A, Lees CC. Evaluation of perioperative complications using a newly described staging system for placenta accreta spectrum. *Eur J Obstet Gynecol Reprod Biol* 2020; **250**: 54–60.
22. di Pasquo E, Ghi T, Calì G, D'Antonio F, Fratelli N, Forlani F, Prefumo F, Kaihura CT, Volpe N, Dall'Asta A, Frusca T. Intracervical lakes as sonographic marker of placenta accreta spectrum disorder in patients with placenta previa or low-lying placenta. *Ultrasound Obstet Gynecol* 2020; **55**: 460–466.
23. Horinouchi T, Yoshizato T, Kojiro-Sanada S, Kozuma Y, Yokomine M, Ushijima K. Missing decidual Doppler signals as a new diagnostic criterion for placenta accreta spectrum: A case described using superb microvascular imaging. *J Obstet Gynaecol Res* 2021; **47**: 411–415.
24. Shih J-C, Kang J, Tsai S-J, Lee J-K, Liu K-L, Huang K-Y. The "rail sign": an ultrasound finding in placenta accreta spectrum indicating deep villous invasion and adverse outcomes. *Am J Obstet Gynecol* 2021; **225**: 292.e1–292.e17.
25. Dall'Asta A, Forlani F, Shah H, Paramasivam G, Yazbek J, Bourne T, Calì G, Lees C. Evaluation of the tramline sign in the prediction of placenta accreta spectrum and perioperative outcomes in anterior placenta previa. *Ultraschall Med* 2022; **43**: e118–e124.
26. Al-Khan A, Alshowaikh K, Krishnamoorthy K, Saber S, Alvarez M, Pappas L, Mannion C, Kayaalp E, Francis A, Alvarez-Perez J. Pulsatile vessel at the posterior bladder wall: A new sonographic marker for placenta percreta. *J Obstet Gynaecol Res* 2022; **48**: 1149–1156.
27. Skupski DW, Duzyj CM, Scholl J, Perez-Delboy A, Ruhstaller K, Plante LA, Hart LA, Palomares KTS, Ajemian B, Rosen T, Kinzler WL, Ananth C; Perinatal Research Consortium. Evaluation of classic and novel ultrasound signs of placenta accreta spectrum. *Ultrasound Obstet Gynecol* 2022; **59**: 465–473.
28. Dokumaci DS, Uyanikoglu H. Shear-wave elastography for detection of placenta percreta: a case-controlled study. *Acta Radiol* 2022; **63**: 424–430.
29. Reddy UM, Abuhamad AZ, Levine D, Saade GR; Fetal Imaging Workshop Invited Participants. Fetal imaging: executive summary of a joint Eunice Kennedy Shriver National Institute of Child Health and Human Development, Society for Maternal–Fetal Medicine, American Institute of Ultrasound in Medicine, American College of Obstetricians and Gynecologists, American College of Radiology, Society for Pediatric Radiology, and Society of Radiologists in Ultrasound Fetal Imaging Workshop. *J Ultrasound Med* 2014; **33**: 745–757.
30. Finberg HJ, Williams JW. Placenta accreta: prospective sonographic diagnosis in patients with placenta previa and prior cesarean section. *J Ultrasound Med* 1992; **11**: 333–343.
31. Del Negro V, Aleksa N, Galli C, Ciminello E, Derme M, Vena F, Muzii L, Piccioni MG. Ultrasonographic Diagnosis of Placenta Accreta Spectrum (PAS) Disorder: Ideation of an Ultrasonographic Score and Correlation with Surgical and Neonatal Outcomes. *Diagnostics (Basel)* 2020; **11**: 23.
32. D'Antonio F, Iacovella C, Bhide A. Prenatal identification of invasive placentation using ultrasound: systematic review and meta-analysis. *Ultrasound Obstet Gynecol* 2013; **42**: 509–517.
33. Jauniaux E, Bhide A. Prenatal ultrasound diagnosis and outcome of placenta previa accreta after caesarean delivery: A systematic review and meta-analysis. *Am J Obstet Gynecol* 2017; **217**: 27–36.
34. Jauniaux E, Chantraine F, Silver RM, Langhoff-Roos J; FIGO Placenta accreta diagnosis and management Expert Consensus Panel. FIGO consensus guidelines on placenta accreta spectrum disorders: Epidemiology. *Int J Gynaecol Obstet* 2018; **140**: 265–273.
35. Melcer Y, Jauniaux E, Maymon S, Tsviban A, Pekar-Zlotin M, Betser M, Maymon R. Impact of targeted scanning protocols on perinatal outcomes in pregnancies at risk of placenta accreta spectrum or vasa previa. *Am J Obstet Gynecol* 2018; **218**: 443.e1–443.e8.
36. Jauniaux E, Silver RM. Rethinking prenatal screening for anomalies of placental and umbilical cord implantation. *Obstet Gynecol* 2020; **136**: 1211–1216.
37. Gyamfi-Bannerman C, Gilbert S, Landon MB, Spong CY, Rouse DJ, Varner MW, Caritis SN, Meis PJ, Wapner RJ, Sorokin Y, Carpenter M, Peaceman AM, O'Sullivan MJ, Sibai BM, Thorp JM, Ramin SM, Mercer BM; Eunice Kennedy Shriver National Institute of Child Health and Human Development (NICHD) Maternal–Fetal Medicine Units (MFMU) Network. Risk of uterine rupture and placenta accreta with prior uterine surgery outside of the lower segment. *Obstet Gynecol* 2012; **120**: 1332–1337.
38. Zhu L, Yang X, Sun W, Qian L, Li S, Li D. Myomectomy scar pregnancy: a case report and review of the literature. *J Int Med Res* 2020; **48**: 300060520924542.
39. Zosmer N, Jauniaux E, Bunce C, Panaiotova J, Shaikh H, Nicholaides KH. Interobserver agreement on standardized ultrasound and histopathologic signs for the prenatal diagnosis of placenta accreta spectrum disorders. *Int J Gynaecol Obstet* 2018; **140**: 326–331.
40. Bowman ZS, Manuck TA, Eller AG, Simons M, Silver RM. Risk factors for unscheduled delivery in patients with placenta accreta. *Am J Obstet Gynecol* 2014; **210**: e1–6.
41. Calì G, Timor-Trisch IE, Palacios-Jaraquemada J, Monteaugudo A, Forlani F, Minneci G, Foti F, Buca D, Familiari A, Scambia G, Liberati M, D'Antonio F. Changes in ultrasonography indicators of abnormally invasive placenta during pregnancy. *Int J Gynaecol Obstet* 2018; **140**: 319–325.
42. Jauniaux E, Zosmer N, Subramanian D, Shaikh H, Burton GJ. Ultrasound–histopathologic features of the utero-placental interface in placenta accreta spectrum. *Placenta* 2020; **97**: 58–64.
43. Abinader RR, Macdisi N, El Moudden I, Abuhamad A. First-trimester ultrasound diagnostic features of placenta accreta spectrum in low-implantation pregnancy. *Ultrasound Obstet Gynecol* 2022; **59**: 457–464.
44. Jauniaux E, Collins SL, Burton GJ. Placenta accreta spectrum: Pathophysiology and evidence-based anatomy for prenatal ultrasound imaging. *Am J Obstet Gynecol* 2019; **218**: 75–87.
45. Haidar ZA, Papanna R, Sibai BM, Tatevian N, Viteri OA, Vowels PC, Blackwell SC, Moise KJ Jr. Can 3-dimensional power Doppler indices improve the prenatal diagnosis of a potentially morbidly adherent placenta in patients with placenta previa? *Am J Obstet Gynecol* 2017; **217**: 202.e1–202.e13.
46. Shainker SA, Coleman B, Timor-Tritsch IE, Bhide A, Bromley B, Cahill AG, Gandhi M, Hecht JL, Johnson KM, Levine D, Mastrobattista J, Philips J, Platt LD, Shamshirsaz AA, Shipp TD, Silver RM, Simpson LL, Copel JA, Abuhamad A; Society for Maternal–Fetal Medicine. Electronic address: pubs@smfm.org. Special Report of the Society for Maternal–Fetal Medicine Placenta Accreta Spectrum Ultrasound Marker Task Force: Consensus on definition of markers and approach to the ultrasound examination in pregnancies at risk for placenta accreta spectrum. *Am J Obstet Gynecol* 2021; **224**: B2–B14.
47. Okoli C, Pawlowski SD. The Delphi method as a research tool: an example, design considerations and applications. *Inf Manag* 2004; **42**: 15–29.
48. Fukushima K, Fujiwara A, Anami A, Fujita Y, Yumoto Y, Sakai A, Morokuma S, Wake N. Cervical length predicts placental adherence and massive hemorrhage in placenta previa. *J Obstet Gynaecol Res* 2012; **38**: 192–197.
49. Cali G, Forlani F, Lees C, Timor-Tritsch I, Palacios-Jaraquemada J, Dall'Asta A, Bhide A, Flacco ME, Manzoli L, Labate F, Perino A, Scambia G, D'Antonio F. Prenatal ultrasound staging system for placenta accreta spectrum disorders. *Ultrasound Obstet Gynecol* 2019; **53**: 752–760.
50. Altraigey A, Ellaithy M, Barakat E, Majeed A. Cervical length should be measured for women with placenta previa: cohort study. *J Matern Fetal Neonatal Med* 2021; **34**: 2124–2131.
51. Hussein AM, Elbarmelgy RA, Elbarmelgy RM, Thabet MM, Jauniaux E. Prospective evaluation of the impact of post-Cesarean section uterine scarification in the perinatal diagnosis of placenta accreta spectrum. *Ultrasound Obstet Gynecol* 2022; **59**: 474–482.
52. Hussein AM, Fox K, Bhide A, Elbarmelgy RA, Elbarmelgy RM, Thabet MM, Jauniaux E. The impact of preoperative ultrasound and intraoperative findings on surgical outcomes in patients at high risk of placenta accreta spectrum. *BJOG* 2023; **130**: 42–50.

SUPPORTING INFORMATION ON THE INTERNET

The following supporting information may be found in the online version of this article:

Figure S1 PRISMA flowchart summarizing inclusion of articles in systematic review.

Table S1 Characteristics of studies identified by systematic review

Table S2 Demographic and clinical characteristics presented in first Delphi round, to identify high-risk patients in whom detailed placenta accreta spectrum (PAS) ultrasound assessment is indicated

Table S3 Second- or third-trimester ultrasound findings that are not related to placenta accreta spectrum (PAS) but may increase the probability of PAS at birth, presented in first Delphi round

Table S4 Distribution of optimal gestational age at which to identify ultrasound signs associated with PAS, according to individual expert preference

Ultrasound Obstet Gynecol 2023; **61**: 518–525
Published online in Wiley Online Library (wileyonlinelibrary.com). **DOI:** 10.1002/uog.26155.

Estudio Delphi modificado de indicios ecográficos asociados al espectro de la placenta acreta

RESUMEN

Objetivo. Determinar, por un consenso de expertos mediante un proceso Delphi modificado, el papel de los indicios ecográficos estandarizados y nuevos en la evaluación prenatal de pacientes con alto riesgo de espectro de placenta acreta (EPA).

Métodos. Antes de elaborar los cuestionarios para la primera ronda del proceso Delphi se llevó a cabo una revisión sistemática de artículos que proporcionaban información sobre los indicios o marcadores ecográficos asociados al EPA. Sólo se incluyeron estudios de investigación originales en inglés revisados por pares que describieran uno o más indicio(s) ecográfico(s) nuevo(s) para la evaluación prenatal del EPA. A continuación, se llevó a cabo un método Delphi de desarrollo de consenso en tres rondas bajo la dirección de un Comité Directivo, que incluía a nueve expertos que invitaron a un panel internacional de expertos en imágenes ecográficas obstétricas para la evaluación de pacientes con alto riesgo de EPA. El consenso se definió como el acuerdo de ≥70% entre los participantes.

Resultados. La revisión sistemática identificó 15 artículos que describían ocho nuevos indicios ecográficos para la evaluación prenatal del EPA. Se contactó a 35 expertos externos, de los cuales 31 aceptaron y participaron en la primera ronda. Treinta expertos externos (97%) y siete expertos del Comité Directivo completaron las tres rondas de Delphi. Se llegó al consenso de que los antecedentes de al menos un parto por cesárea, miomectomía o EPA deberían ser un indicio para una evaluación ecográfica detallada del EPA. Los panelistas también llegaron al consenso de que siete de los 11 indicios convencionales del EPA deberían incluirse en el examen de las pacientes de alto riesgo y en el informe rutinario de la ecografía a mitad de la gestación: (1) pérdida de la 'zona clara', (2) adelgazamiento del miometrio, (3) interrupción de la pared vesical, (4) abombamiento de la placenta, (5) hipervascularización uterovesical, (6) lagunas placentarias y (7) vasos puente. No se alcanzó un consenso para ninguno de los ocho nuevos indicios identificados por la revisión sistemática. Con respecto a otras características ecográficas que no son específicas del EPA, pero que aumentan la probabilidad de EPA en el momento del nacimiento, los panelistas llegaron a un consenso para el hallazgo de placenta previa anterior o placenta previa con afectación cervical. También se pidió a los expertos que determinaran qué indicios de EPA debían cuantificarse y sólo se llegó a un consenso para la cuantificación de las lagunas placentarias utilizando una puntuación existente. Para predecir el resultado quirúrgico en pacientes con una alta probabilidad de EPA en el parto se llegó a un consenso para la pérdida de la zona clara, la interrupción de la pared vesical, la presencia de lagunas placentarias y la presencia de placenta previa con afectación del cuello uterino.

Conclusión. Se confirmó la importancia continuada de siete indicios ecográficos estandarizados establecidos de EPA, se destacó el papel de la ecografía transvaginal en la evaluación de la posición placentaria y la anatomía del cuello uterino, y se identificaron nuevos indicios ecográficos que pueden resultar útiles en la futura evaluación y tratamiento prenatal de pacientes con alto riesgo de EPA en el momento del nacimiento.

与胎盘植入性疾病相关的超声征象的改良德尔菲研究

摘要

目的 通过改良的德尔菲程序建立专家共识，确定标准化和新的超声征象在胎盘植入性疾病（PAS）高风险患者产前评估中的作用。

方法 在制定第一轮德尔菲程序的调查问卷前，对提供与PAS相关的超声影像征象或标志相关信息的论文进行了系统回顾。只纳入了阐述用于产前评估PAS的一个或多个新的超声征象的经同行评议的英文版原始研究。然后在指导小组的指导下进行了三轮建立共识的德尔菲法讨论，指导小组包括9位专家，他们邀请了产科超声成像方面的国际专家小组对PAS高危患者进行评估。共识的定义是参与者之间的一致性≥70%。

结果 系统回顾确定了15篇文章，描述了用于产前评估PAS的8种新的超声征象。共接触了35位外部专家，其中31位同意并参与了第一轮。30位外部专家（97%）和指导小组的7位专家完成了所有三轮德尔菲讨论。达成的共识是，既往至少经历过一次剖宫产、子宫肌瘤切除术或PAS的历史应作为详细的PAS超声评估的一个指征。小组成员还达成共识，认为PAS的11个常规征象中，有7个应包括在高风险患者的检查和常规孕中期扫描报告中：(1)“透明区”消失，(2)子宫肌层变薄，(3) 膀胱壁中断，(4)胎盘隆起，(5)子宫膀胱部位血管过多，(6)胎盘裂隙和(7)桥血管。系统回顾所确定的八个新征象中，没有一个达成了共识。关于其他不是PAS特有的、但会增加出生时PAS概率的超声特征，专家们就发现前部前置胎盘或有宫颈参与的前置胎盘达成了共识。专家们还被要求确定哪些PAS征象应该被量化，并只对使用现有评分的胎盘裂隙的量化达成了共识。对于预测分娩时PAS高概率患者的手术结果，对透明区消失、膀胱壁中断、存在胎盘裂隙和存在涉及宫颈的前置胎盘达成了共识。

结论 我们证实了七个既定的PAS标准化超声征象的持续重要性，强调了经阴道超声在评估胎盘位置和宫颈解剖方面的作用，并确定了可能在未来产前评估和管理出生时PAS高风险患者方面有用的新的超声征象。

ORIGINAL PAPER